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Original Research

Neo Automatic Code to Improve Quality of Cardiopulmonary Resuscitation (CPR) in Society

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ABSTRACT

Background: *The quality of cardiopulmonary resuscitation (CPR) in Indonesian society is poor. One solution is to give society a metronome called the Neo Automatic Code (NAC) to guide CPR when cardiac arrest patients are present. This study aims to analyze the effect of NAC on the compression depth and compression rate during CPR.*

Methods: *A quick experimental study with a control group design, where the population is chosen by simple random sampling to distinguish between odd and even. The population is health cadres and youth with an age range of 16-56 years. The intervention group gets training 2 times to do CPR with Neo Automatic Code, and the control group gets training in CPR using standard procedure. We use a CPR manikin to measure variables. Data analyzed used Mann Whitney.*

Results: *The Mann-Whitney test shows p = 0.001, concluding that there is a difference in the accuracy of depth and compression speed in CPR between the intervention and control groups. This means the NAC metronome can improve CPR performance in compression depth and compression rate. CPR uses a neo-automatic code metronome to ensure the user breathes regularly and helps the rescuer to constantly give compression.*

Conclusion: *Neo automatic code can improve the quality of CPR in Indonesian society. A study about how many times training must be given to society, considering age, level of education, and kinds of jobs, is needed.*

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INTRODUCTION

Globally, one of the leading causes of morbidity and death is out-of-hospital cardiac arrest (OHCA) (Simmons et al., 2023). Cardiac arrest is a condition where the heart stops beating abruptly when it malfunctions. It's not the same as a heart attack. An electrical malfunction in the heart causes the heart to stop beating normally. A heart attack is caused by a circulation problem in the arteries, which prevents blood from reaching the heart. A heart attack is a risk factor associated with cardiac arrest, although not all heart attacks cause cardiac arrest (American Heart Association, 2020).

Over 30,000 out-of-hospital cardiac arrests (OHCAs) occur in the UK each year, during which time emergency medical personnel try to revive the victim. Less than 10% of people in the UK survive an OHCA, which is a low survival rate (Perkins & Brace-Mcdonnell, 2015). Annual rates between 55 and 113/100,000 person-years are associated with out-of-hospital cardiac arrest with low survival rates (Nikolaou, 2019).

Up to 30% of all cases of out-of-hospital cardiac arrest are due to cardiac arrest (OHCA), which achieves the return of spontaneous circulation. Only 10% survive, such that a substantial proportion of 10% survive (Hessulf et al., 2023). The majority of cardiac arrests are witnessed by someone who could initiate this life-saving intervention, yet rates of bystander CPR in many systems are disappointingly low. One key challenge is that bystanders may be untrained or uncomfortable performing CPR without assistance (Nikolaou, 2019).

Education and awareness about cardiac arrest and the importance of immediate medical care can improve the chances of survival. Unfortunately, only 10% of victims were interviewed in the public inquiry. Unfortunately, only 10% of victims were interviewed in the public inquiry. With 4,444 people experiencing cardiac arrest outside of the hospital, there is a general lack of awareness about cardiac arrest and the need for immediate medical intervention. Even laypeople who are aware of cardiac arrest and the benefits of early rescue may be anxious about their ability to assist, fear harming the victim, or fear personal responsibility, and support may not be provided. Providing information to the public about cardiac arrest and training in intervention techniques will improve the chances that cardiac arrest victims will be identified and receive the help they need to survive (American Heart Association, 2020).

Bystander cardiopulmonary resuscitation (CPR) is an independent factor in improving OHCA survival. However, the prevalence of bystander CPR remains low worldwide. Community interventions such as mandatory CPR training in schools or CPR training targeting family members of high-risk cardiac patients are possible strategies to improve bystander CPR rates. Immediate feedback, hands-on practice with manikins, and metronome assistance can improve CPR quality. Operator assistance and compression-only CPR for untrained bystanders have been shown to improve bystander CPR rates and improve survival to hospital discharge (Liou et al., 2021).

High-quality cardiopulmonary resuscitation (CPR) is essential to ameliorate the survival rates. Thus, numerous reanimation-aid-aiding biases have guidelines that try to set clear and simple criteria for high-quality CPR, and acceptable operation of these criteria is tried in all CPR training. Despite all the sweats, a standard CPR operation is generally not possible because reanimation providers are different groups and have different particular approaches and gestures. Also, indeed among health professionals, these criteria can be achieved at different rates (Caliskan et al., 2021). Suggestions by Simmons et al., (2023) that towns, regions, and nations incorporate community-based interventions into their pre-hospital approach for OHCA are informed by these findings. Initiatives should be long-term and sustained for maximum impact (Simmons et al., 2023).

High-performance cardiopulmonary resuscitation (CPR) relies on effective chest compressions, which are affected by depth, rate, fraction, and recoil. In particular, published data on compression rate has demonstrated that in comparison to rates between 100 and 120, rates below 100 and over 120 are linked to inferior clinical outcomes. This research is reflected in the most recent American Heart Association guidelines, which suggest doing chest compressions at a rate of 100 to 120

compressions per minute. Chest compression rate targets can be better adhered to when auditory or visual aids are used (Kennedy et al., 2023).

With a speed of 100x per minute, the neo-automatic code application is a voice code (one two three four five six seven eight nine one one two three four five six seven eight nine two one two three four five six seven eight nine three take a breath take a breath). An automatic code applied to a manikin at a pace of 100x/minute produced an average of 97.67 compressions in 1 minute. The depth of chest compression, which was at a depth of 5 cm, was 82.86%. The rescuer no longer has to count the number of chest compressions when using the Neo Automatic Code Application to calculate them (Darmawan et al., 2021). The aim of the study is to analyze the effect of NAC on the compression depth and compression rate during CPR.

MATERIALS AND METHOD

This study used a quantitative quasi-experimental pre-post test with a control group design method. Sampling was carried out using a purposive sampling technique. The treatment group was a sample of 38 health cadres in Karanganyar, and the control group was 32 youth organizations. The treatment group was trained twice in CPR with NAC, while the control group was taught how to perform CPR conventionally. The activity was carried out in June-September 2024, where the researcher recruited four enumerators whose measurement techniques had been calibrated.

The calibration technique used is that the researcher conveys the title and purpose of the research to the enumerator. The enumerator tries to perform chest compressions on the CPR mannequin. Furthermore, in pairs, the enumerators calculate each other's number of compressions and the appropriate compression depth. If there is a difference, the enumerator is retrained. If the count of each enumerator is the same, then the enumerator is ready to collect research data.

The variables measured were the depth and speed of chest compressions. The depth of chest compressions is indicated according to when the CPR mannequin light is on, which is calculated in percent (%) with the formula for the number of correct compressions divided by the total number of compressions. Chest compression speed is the number of chest compressions of respondents in 1 minute.

The Kolmogorov-Smirnov normality test results showed that the data was not normal in both variables with a value of 0.01, so the data was analyzed using the Mann-Whitney test. The research is in the process of ethical approval from KEPK RSDM with the number 2.545/X/HREC/2024.

RESULTS

The study had 70 participants in total, with 32 youth groups serving as the control group and 38 health cadres serving as the intervention group. In the intervention group, 92% of the participants were female and 8% were male, with a median age of 48 (IQR 36–56) years. In the control group, 53% of the participants were female and 47% were male, with a median age of 20 (IQR 16–29) years. Every respondent had never before undergone CPR instruction. Table 1 presents the characteristics of the participants. One hundred percent of participants said that using the metronome improved their performance (Table 1).

Table 1. Study participant characteristics

Parameters	Intervention Group	Control group
Age, median (IQR)	48 (IQR 36–56)	20 (IQR 16–29)
Male sex; n (%)		
Male	92	53
Female	8	47
CPR Training; n (%)	0	0
Do you believe that using the metronome improves your CPR performance? Agree	100%	-

After two CPR trainings Table 2, The NAC metronome was used more frequently than not to apply enough chest compression depth (>60%) during CPR (54% (IQR 42–85) vs. 34% (IQR 20–56), P < 0.001). The NAC metronome group's pre-post conditions improved by 8% (IQR 0–24) compared to 54% (IQR 42–85), P < 0.001, while the control group's pre-post circumstances improved by 6.7% (IQR 0–17) compared to 34% (IQR 20–56), P < 0.001.

Before training, the compression rate for respondents in the intervention group was 67 (IQR 30–141), while the control group did not utilize a metronome (72 (IQR 43–138), P < 0.001). Following training, the NAC metronome was used to obtain the ideal speed level during CPR (98 (IQR 96–102)), while the control group did not utilize a metronome (113 (IQR 62–128), P < 0.001) (Table 2).

Table 2. Effect NAC to the compression depth and compression rate

Parameters	Intervention Group	Control group	P
Compression Depth			
Pre Test	8% (IQR 0–24)	6.7% (IQR 0–17)	0.001
Post Test	54% (IQR 42–85)	34% (IQR 20–56)	
Compression Rate			
Pre Test	67 (IQR 30–141)	72 (IQR 43–138	0.001
Post Test	98 (IQR 96–102)	113 (IQR 62–128)	

Table 2 shows the difference in variable compression depth and compression rate between the intervention and control groups with P 0.001. This means the NAC metronome can improve CPR performance in compression depth and compression rate.

DISCUSSION

The results of the study show that the compression depth and compression rate of CPR can be enhanced with the use of an NAC metronome. This study is linear with Caliskan's (2021) report that the use of a metronome during CPR simulation increases compression depth and recoil by increasing the chest compression rate. Caliskan (2021) advises healthcare personnel to receive CPR instruction using a metronome (Caliskan et al., 2021; Kennedy et al., 2023).

According to two-thirds of the participants, using the metronome improved their performance, and they intended to continue using it as part of their regular CPR exercises (Caliskan et al., 2021). CPR uses a neo-automatic code metronome to ensure the user breathes regularly and helps the rescuer to constantly give compression. A

study carried out in Japan revealed a substantial interaction between chest compression depth and rate during simulated resuscitation when examining studies that looked into the relationship between compression rate and depth and/or recoil.

The most high-quality CPR compressions were at a compression rate of 120/min, whereas the rate of incomplete chest compressions was lower at 100 and 120/min. According to a different study, high school students performed more incomplete chest compressions at rates higher than 120 beats per minute, but they also reported noticeably deeper chest compression depths. We think that by maximizing the rate, the metronome enhances compression depth and recoil (Caliskan et al., 2021).

Regardless of the chest-compression technique used, the use of audio feedback generated by a metronome during cardiopulmonary resuscitation (CPR) on a patient experiencing cardiac arrest in an out-of-hospital setting may increase the rate of achieving adequate chest compression depth (CCD), an adequate chest compression rate (CCR), and complete recoil between chest compressions (CCR) during CPR. However, when CPR performance was directed by metronome-produced sound, a decrease in CCD was noted for both OHCC and THCC. Therefore, when performing cardiopulmonary resuscitation (CPR) on patients experiencing cardiac arrest outside of a hospital, we shouldn't rely just on aural feedback generated by a metronome.

To guarantee that both an appropriate CCD and an adequate CCR are attained, in addition to using metronome feedback, the concurrent usage of necessary feedback mechanisms that can be utilized to rectify CCD and attain acceptable CCD (Yang et al., 2021). During CPR, the audio metronome is a useful instrument that is simple to use, versatile, and helps reach a goal chest compression rate with minimal deviation from that objective (Kennedy et al., 2023). By reducing hyperventilation and maximizing compression depth without producing fatigue, the metronome—which has a melodic beat made up of two distinct sounds for compression and ventilation—is a useful instrument for achieving the desired compression rate. Using a metronome could be a simple and affordable method of improving CPR parameters (Ocak et al., 2020).

A study from Watanabe et al., (2017) reports that students only learned how to use an automated external defibrillator and perform chest compressions as part of their BLS training. Before and after their initial schooling, students took skills and knowledge tests, which were then given again two and four months later to gauge retention. Comparing pre- and post-education outcomes for all time points revealed a substantial increase in CPR knowledge and skills ($p = 0.001$).

Although not during the actual CPR steps, there was a notable gain in overall knowledge scores when evaluating reeducation. After a single 45-minute course, our study shows a significant boost in CPR knowledge and skills. Reeducation might be beneficial, but further research is required to determine the interval. Investing one 45–60 minute time each school year in schools across the US would guarantee that everyone knows how to perform CPR with minimal cost (Watanabe et al., 2017).

Effective breathing volumes and chest compression depths can be attained on training manikins by the age of ten to twelve. It is advised to combine theoretical and practical instruction. Basic life support can be effectively taught by schoolteachers. By teaching others fundamental life support skills, schoolchildren also act as multipliers. For students of all ages, using age-appropriate social media resources for instruction is a viable strategy.

Basic life support instruction for schoolchildren has the potential to improve survival rates following out-of-hospital cardiac arrest and teach entire generations how

to respond to cardiac arrest. To improve schoolchildren's basic life support education, comprehensive laws, curricula, and scientific evaluation are essential (Schroeder et al., 2023). Given that it is a crucial prognostic component during resuscitation, the compression fraction is a critical evaluation result. The patient's chances of survival will decline if CPR is not performed right away (Brophy et al., 2023).

Whether or not the initial cardiac arrest rhythm responds to defibrillation, improved survival follows cardiac arrest. This suggests that additional factors, such as early cardiac arrest detection, the effectiveness of acute resuscitation, feedback devices to maximize the efficacy of CPR, and post-resuscitation care, may also contribute to improved survival. This implies that the public must know the best times to begin CPR (Goharani et al., 2021).

Lay rescuers seem to have trouble correctly assessing breathing, which might be lessened by providing more thorough instructions. Consequently, standardized, clear instructions on how to perform airway assessment should be included in CPR protocols. It is important to assess each protocol's viability. In addition to learning how to perform chest compressions, lay rescuers should also learn how to keep the patient breathing (Hölzing et al., 2023).

CONCLUSION

The quality of compression depth and chest compression rate is enhanced when NAC metronome devices are used during public CPR simulation training. Using a metronome during cardiopulmonary resuscitation (CPR) on a patient experiencing cardiac arrest in an out-of-hospital setting may increase the rate of achieving adequate chest compression depth (CCD), an adequate chest compression rate (CCR), and complete recoil between chest compressions (CCR) during CPR. Therefore, to improve the survival rate in Indonesia, we advise the general population to employ metronome devices during CPR instruction.

As first responders for patients experiencing cardiac arrest, lay rescuers will reduce handling time and improve the likelihood that patients will survive. To determine the ideal chest compression depth for lay rescuers, more research is required about the number of training sessions required. The age at which Indonesians should be given CPR training, similar to that of Japan and other affluent nations, must also be determined.

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